Toward a theory of curriculum design and use

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Introduction

Curriculum materials have long played a central role in educational reform, with mixed results (Ball and Cohen 1996; Cohen 1988; Cuban 1992; Cuban 1993). Explanations for the continual disappointments of curriculum-based reforms have focused on practitioners (Cohen 1990; Spillane 1999), policies (Spillane 1998), and professional development (Putnam and Borko 2000; Wilson and Berne 1999). Recently, researchers begun to focus more attention on how teachers interpret and use innovative curriculum resources (Ben-Peretz 1990; Brown 2002; Drake and Sherin 2002; Lloyd 1999; Remillard 2000) as well as how designers might create resources that better accommodate instruction (Brown 2002; Brown and Edelson 2003; Schneider and Krajcik 2002).

A key challenge to improving the impact of materials on practice is understanding how curricular artifacts embody and represent instructional ideas and the different ways in which these designs constrain and afford teacher practice. This paper confronts this challenge by developing a theoretical platform for understanding teachers' interactions with curricular artifacts and a design language for discussing the composition of the artifacts themselves. It starts by framing teachers' use of curricular artifacts as a design activity and explores this perspective in light of cognitive theory on the role of artifacts in shaping human activity. Next, it explores a study that revealed a way of understanding the different ways that teachers interact with curricular artifacts. It concludes by presenting a technology system for the design and delivery of instructional resources that engages teachers in active use and customization of curriculum materials.

There is good reason to be skeptical about the influence curriculum materials can have over teacher practice. The use of curriculum materials provides no guarantees of instructional transformation. If, however, we appreciate that teaching is a process of design and we view materials as resources to support such a process, then the errand of such materials shifts from transmitting instruction to transforming it by serving as a catalyst for local customization. More than mere conduits for reforms, materials that support teacher-design stand a better chance of engaging practitioners with the curricular ideas the reforms intend to foster.

Teaching as design

Teacher practice is, in many ways, a design activity. Teachers must perceive and interpret existing resources, evaluate the constraints of the classroom setting, balance tradeoffs and devise strategies – all in the pursuit of their instructional goals.

The interpretation of teaching as design is relatively new. Yet the notion of teachers as designers is compatible with a range of established cognitive theory that emphasizes the role of artifacts in determining human activity (Cole 1996; Norman 1988; Norman 1991; Pea 1993; Wertsch 1991; Wertsch 1998). This theory base brings to light three key points for understanding the interaction between teachers and curriculum artifacts: (a) curriculum materials play an important role in affording and constraining teachers' actions; (b) teachers notice and use such artifacts differently given their experience, intentions and abilities; and (c)

Teaching by Design is not so much a conscious choice but an inevitable reality.

This section will explore the nature of artifacts in affording and constraining human activity and apply this perspective to teachers' use of curriculum materials. This will provide a foundation for understanding teaching as a design activity.

Background: Understanding Curriculum Artifacts

According to Marx Wartofsky, artifacts are tools created by humans as a means of producing and reproducing the means of existence (Wartofsky 1973). Artifacts, he claims are created through a purposeful transformation of part of the environment for the purposes of survival. This applies both to the physical tools we use, as well as the language, social organizations, and divisions of labor that help us to accomplish the needs of existence.

Given their function in species survival, a crucial element of artifacts is that they can be transmitted, and thus preserved, across time and place. To do this, humans require a means of symbolically communicating—or representing—these artifacts and the skills involved in their use. Such representations thus become artifacts themselves. Artifacts, therefore, include not only tools used to accomplish modes of action, but also those used to represent and transmit such modes of action through social and cultural arrangements. In the context of curriculum materials, the former type of artifact includes physical objects such as rulers, microscopes, and pencils, whereas the latter type includes lesson plans, teacher guides, and texts.

Artifacts can extend human capacities. A key feature of artifacts is that they assist people in achieving goals that they could not accomplish on their own. In many instances of accomplishment, humans and artifacts are inseparable. For example, Wertsch's (1998) discussion of the history of pole vaulting reveals the difficulty in separating the contributions of the athlete and the pole in vaulting to new heights. It is ridiculous, he claims, to attempt to consider the task by isolating either the pole or the agent, for neither can engage in the activity without each other. Rather, the two elements must be considered in terms of a dynamic interaction. A similar relationship exists between "cognitive" tools such as calculators. As Pea (1985) observes, an individual's ability to accomplish complex mathematical calculations using such tools cannot be understood solely in terms of mental capacity, since such partnerships are characterized by the "sharing" of functional capacity across people and tools.

Artifacts mediate action. Another important property of artifacts is that they *mediate* activity in very specific ways. Given the fundamental role of artifacts in human activity, it follows that the nature and composition of a specific tool will have a significant influence on the nature of the tasks that can be accomplished with it. This notion of *mediated action*, derived from Vygotsky (1978) and advanced by Wertsch (Wertsch 1991; Wertsch 1998), emphasizes *affordances* and *constraints* that artifacts place on activity.

These two terms serve to describe the range of possibilities and limitations that artifacts may present for human activity. They essentially represent two sides of the same coin. In fact, Wertsch (Wertsch 1998) explains the role of affordances and constraints in terms of the "half-empty" and "half-full" views. The "half-full" outlook emphasizes the enabling potential of mediating artifacts. Gibson (1977) used the term *affordances* to describe the functional properties that determine how an item may be used. Norman (1988) expanded on this notion at great length by describing the ways in which everyday objects signal intended uses through perceptual cues. For example, a pliers sends a strong perceptual message that it is *for* grabbing hold of an object. Such perceptual features can, in the words of Brown and Duguid (Brown and

Duguid 1995), "provide peripheral clues that subtly direct users along particular interpretive paths by invoking social and cultural understandings."

On the other hand, the "half-empty" outlook points out that the tools we use not only open doors to new experiences, but also place important restrictions on activity. According to this view, our ability to act on reality is inherently limited, or *constrained*, by the tools we use. Kenneth Burke (1966; Wertsch 1998) referred to these constraining properties of artifacts as "terministic screens." One quickly understands this notion when attempting to use an activity guide to characterize the richness of a classroom instructional setting. In such cases, the tools available—namely, a document containing words and diagrams—define the terms in which the task can be accomplished. But while constraints imply limitation, they need not be viewed merely as negative hindrances. Rather, constraints can just as readily be viewed in terms of how they *define* the nature of the task, and these definitions can help to provide meaning and coherence. For example, a designer's choice to include in curriculum materials certain descriptions of the subject matter over others can productively *constrain* a teacher's interaction with the curriculum, thus serving to influence classroom instruction in specific ways. Thus, constraints may be viewed in terms of their capacity to *define* activity as their capacity to *hinder* it.

Implications for the Teacher-Tool exchange

The faith in artifacts to afford and constrain human activity is at the core of many curriculum-based reforms. According to Norman (1988), humans commonly design artifacts with the capability to "cue" activity through constraints & affordances. Thus it is possible to craft purposefully artifacts which, through their constraints and affordances, can trigger or cue certain types of activity. The viewpoint expressed here emphasizes the ways in which curriculum artifacts (e.g., lesson plans, domain representations, lab tools) afford and constrain the instructional activities of individual teachers, and the skills that these teachers bring to bear in employing such artifacts. The implication of this perspective is that materials can be designed in ways that stand a greater chance of influencing practice according to the designers' intent.

Furthermore, research has shown that when teachers interact with curriculum artifacts, they do so in dynamic and constructive ways (Barab and Luehmann to appear; Ben-Peretz 1990; Brown 2002; Remillard 2000). This highlights the importance not only of the constraining and affording potential of curriculum artifacts, but also the ways in which teachers perceive and interpret their features. Thus, the capacities of teachers and the contexts and circumstances in which the interactions take place are also of vital importance.

Empirical foundations

Examining teaching as design helps to illustrate the dynamics that influence the outcomes of teachers' use of curriculum materials. This paper argues that teachers' interactions with instructional materials can be understood in terms of different degrees of artifact appropriation: *offloading*, *adaptation*, and *improvisation*. At one extreme, teachers *offload* responsibility for guiding instructional activity onto the materials. In such cases, teachers rely on the materials to support aspects of instruction. At the other extreme, teachers *improvise* their own strategies for instruction in response to, but with minimal reliance on, the materials. In between, teachers *adapt* the curriculum resources in ways that reflect contributions of both the materials and personal resources.

To understand these different types of interaction, it is necessary to examine the dynamic interplay between teachers and the curricular artifacts they use. Consider the following

example, summarized from a larger study that examines the intersection between teacher practice and the design of curricular innovations (Brown 2002).[1]

A middle school science teacher in an urban classroom setting implements, as part of a 10-week inquiry based project on global climate change, enacts a sequence of activities on the intensity of incoming solar energy.[2] Roughly, the curriculum materials describe and support the following steps:

(1) A classroom lab in which students shine pen-lights onto graph paper and trace the area of reflected light at each angle. The lab is intended to model the different angles of incidence at which sunlight reaches Earth's curved surface.
(2) Analysis of the lab results, in which students calculate the ratios of intensity at each angle.
(3) Discussion of the results—namely, the role of angle of incidence in determining light intensity.
(4) Discussion of the relationship between the lab model and the Earth-Sun relationship, as well as the strengths and weaknesses of the simulation.

The analysis of the teacher's use of the curriculum materials illustrates three basic patterns of use. First, while the materials provide a detailed recipe that guides teachers and students through the steps of assembling the lab models, this teacher decided instead to engage her students in designing their own versions of the lab. In this case, the teacher adopted the essential structure and format provided in the recipe, but rather than giving it to the students in the form of explicit instructions, she used it herself as a basis for informing her coaching of the students. She also displayed a deep enough understanding of the model's overall rationale to guide students in creative substitutions of materials without compromising the model's accuracy.

Second, the materials provided instructions and sample work for a calculation to establish a quantitative pattern in intensity that mirrors the visible pattern. In this case, the teacher relied verbatim on the lesson plan's scripted instructions to lead students through each step of the calculation.

Third, the materials provided support for a discussion that helps students connect the features of their lab models to the actual phenomena they represent. During this exchange, the teacher

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[1] The research summarized here is part of a larger study that examines the intersection between teacher practice and the design of curricular innovations. It explores the ways that three urban middle school teachers interacted with the materials in a specific middle school unit, the 10-week inquiry-based Global Warming Project, devoting particular attention to the nature of the curriculum designs and the ways that teachers used these resources to design instruction. The research involved multiple cycles of observation and analysis of classroom practice based on qualitative investigation of classroom video, teacher interviews and the curricular artifacts themselves (for details, see Brown 2002). This paper focuses on the experience of one of the teachers, but the patterns described were consistent across all three cases.

[2] The examples discussed in this paper center around a sequence of activities that investigate the angle of incidence at which sunlight reaches the Earth's surface and impacts the intensity of the light—and thus the energy—it receives. In the Sun's Rays Lab, students use pen lights and graph paper to model the Earth-sun relationship, measuring the areas cast by the light at different angles of incidence. With this data, students extrapolate the diminishing intensity that occurs as the light "spreads" over larger areas. Students also use the WorldWatcher data visualization software to explore geographic variation in the intensity of solar energy. For a more detailed explanation of these activities, see Brown & Edelson (1999) and Sherin, Edelson, & Brown (to appear). The full Global Warming Project is available at <http://www.letus.northwestern.edu/projects/gw/>.

seized upon a disagreement between two students in order to initiate a multi-day debate on competing interpretations of the model—a complete departure from the original design that nonetheless achieved compatible goals.

These and other examples suggest a scale that characterizes the different extents to which the teacher offloaded, adapted or improvised with the materials in the performance of instructional tasks. At one extreme of the spectrum, the teacher *offloaded* responsibility for guiding instructional activity onto the materials. In these cases, she relied on the materials to support aspects of instruction. At the other extreme, she *improvised* her own strategies for instruction with minimal reliance on the materials. In between, she frequently *adapted* the curriculum resources in ways that reflected contributions of both the materials and personal resources. In short, these three types of use describe the differential degrees in which responsibility for guiding instructional activity is distributable between the teacher and available instructional resources.

To understand the nature of distribution in this scale, the study adopts a two-pronged analysis. On one hand, it examines teachers' goals, knowledge, skills, and commitments and how they influence how teachers perceive and appropriate different aspects of curriculum designs. On the other hand, it examines the design features and embedded knowledge that comprise curriculum materials—including representations of action (e.g. procedures and task structures), representations of content (e.g., diagrams and verbal explanations), and representations of physical objects (e.g., lab setups). These aspects reflect the implicit and explicit intentions of curriculum designers.

Each instance cited above is explainable in terms of this interaction between teacher resources and curriculum resources. For example, the teacher's stated discomfort with the types of mathematical operations in the intensity calculation helps to explain her reliance on the curriculum script:

> "[The intensity calculation] is driving me nuts… Each day I think I will try it today and then… I mean it took me two days of doing it to figure out why I am doing it." (Email correspondence with researcher)

On the other hand, her extensive experience with modeling activities is behind her adaptation of the lab into a modeling activity, as we see in her justification for the changes:

> "When I do labs now, I try to be very careful to not be so prescriptive that I eliminate the opportunity for the kids to use creative thought in setting up a lab. So, the first day, I did not give them the lab sheet. I just said we were going to check out this angle question and here was what we were going to use… I let them have the rest of that period to devise a set up." (Interview with researcher)

Similarly, the teacher's desire to nurture authentic scientific practices led her to seize upon an opportunity presented by, but not supported in, the curriculum. That she transformed a recommended discussion comparing the lab model to the actual Earth-Sun relationship into a spontaneous, student-driven classroom debate on the competing interpretations stems in large part from her stated goal of engaging students in scientific discourse and understanding of the nature of scientific models.

Both aspects of the analysis are necessary to understanding the dynamics of curriculum implementation. The nature of teachers' resources influence their capacities and inclinations to notice, interpret and use features of the curriculum materials. By the same token, the manner in which the contents of curriculum is designed and represented determines how they are

perceived and used. In each example, the materials provided meaningful affordances and constraints that served, respectively, to structure, influence, and inspire instruction during the various stages of the activity sequence.

These different types of interactions are captured in the Design Capacity for Enactment framework (Figure 1), which represents the different types of interactions that occur between teacher resources and curriculum resources as teachers adapt, adopt or improvise with curriculum resources.

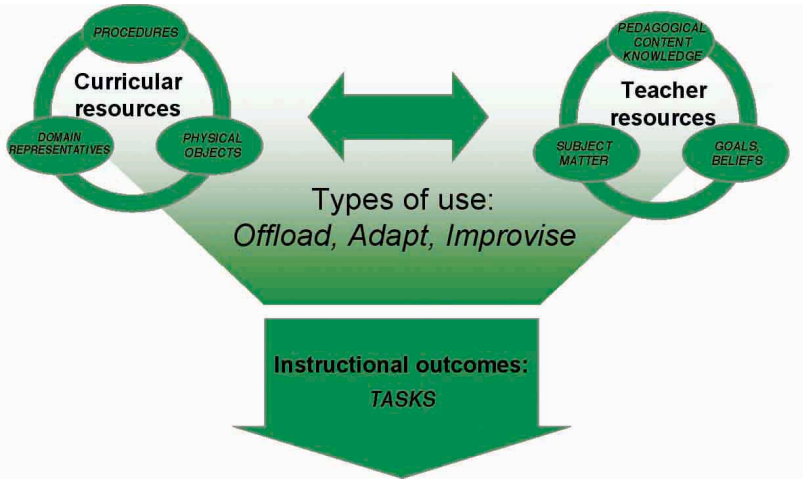

Figure 1. The Design Capacity for Enactment Framework

This framework provides a starting point for a more fine-grained analysis of what it means to represent curricular ideas in materials, and what it means to perceive and use these designs in practice. The hope is that this perspective can support a design theory for instructional materials that better accommodate and support the constructive and creative teaching processes called for by current instructional reforms.

Design Implications and Applications

One way to realize the potential of Teaching as Design is to rethink traditional modes of curriculum design, dissemination and use. Rather than designing curriculum materials as "one-size-fits-all" documents, efforts must be made to support different modes of use by diverse teachers. The materials should be flexible enough to accommodate offloaders as well as adapters and improvisers. And the materials should be presented in ways that help users explore resources in light of their specific curricular aims. Furthermore, dissemination must occur in a context that supports teachers in crafting customized solutions that meet their own instructional goals and their students' needs.

The challenge in designing a system to support multiple goals and users with varying levels of instructional design and content expertise is finding the appropriate balance between being *sufficiently open-ended to accommodate flexible use, yet be sufficiently constrained to provide coherence and meaning with respect to its intended uses*.

In an initial attempt to realize the principles of Teaching by Design, we designed an online system to support the dissemination and local adaptation of instructional resources by teachers. The system, dubbed "***AIM***"(Adaptive Instructional Materials) integrates an indexed

and annotated database of electronic resources with the ability to compose and adapt such resources into personalized lesson and course plans. *AIM* is designed to accomplish two primary objectives: (1) to support teacher engagement with the concepts and issues of a given subject area, and (2) to support teachers with resources and activity ideas that they can use to create or adapt instructional materials of their own.

AIM was originally designed to support teaching about the principles of learning and assessment, as embodied in recent NRC reports *How People Learn* (Bransford, Brown and Cocking 2000) and *Knowing What Students Know* (Pellegrino, Chudowsky and Glaser 2001). The targeted audiences are college level teacher education and in-service professional development. While these represent very different instructional contexts than the middle school science classrooms described earlier, the design of the system nonetheless draws directly on the principles of *teaching as design* described in the study.

Design Principles for Supporting Teacher Engagement

Much work has been done on the development of flexible instructional materials at both the levels of system design and curriculum development. For instance, research on "learning objects"(Wiley 2001) has attempted to explore the use of "modular" and "reusable" learning resources that can be pieced together in various forms depending on the particular needs of their users. At the other extreme, researchers have studied the stifling impact that "scripted curricula" can have on teachers' agency in addressing the plethora of unique issues and needs that arise in their classrooms during instruction (e.g., Ben-Peretz 1990). Our approach to curriculum design attempts to deal with these tradeoffs by working from two main principles.

Multiple points of access. The first principle is to *support a range of instructional and content expertise by providing multiple points of access to the instructional resources*. "Expert" teachers who possess familiarity with the subject matter and how to teach it can browse or search the database, assembling collections of resources that they can later import into a course authoring tool. Novice teachers can use pre-authored courses and sessions "as-is". In between these two extremes, teachers may adapt existing courses or sessions by adding or subtracting resources, altering the enactment plan, or modifying the learning objectives.

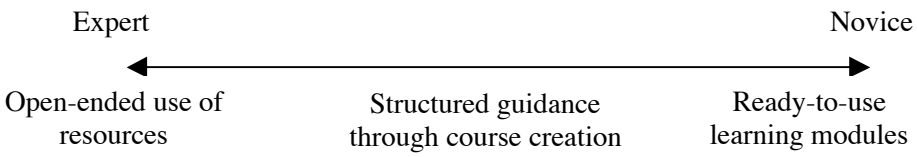

Figure 2. Supporting Users with a Range of Expertise

Resource-centric curriculum design. The second principle is to *adopt a "resource-centric" approach to curriculum design that allows for reuse and adaptation in multiple instructional contexts*. The "resource-centric" approach emphasizes the key building blocks of a lesson over its procedural steps. In doing so, this approach attempts to make visible the pedagogical affordances of such building blocks in ways that promote more mindful engagement on the part of teachers. This approach also seeks to avoid the highly contextualized qualities of procedure-centric approaches by highlighting multiple ways in which resources may be used and organized within lessons. It does not eschew procedures (indeed procedures are one among many available instructional resources), but it avoids using them as the core organizing element.

To illustrate the resource-centric approach to design, consider the analogy of the Container Store, which provides customers with an array of modular solutions for space organization. The key to its success lies in helping customers to understand the different uses of each element and the different ways they can fit together to address particular needs. By contrast, a prefabricated, "one size fits all" closet solution is likely to require dismantling and reassembly by users in order to fit their unique goals and needs.

In order to illustrate how our design reflects these principles, we first briefly describe the two main *AIM* features: the Explorer, a searchable database of instructional resources, and the Course Creator, a design tool for constructing customized lessons and courses. We then turn to some key design issues we faced that demonstrate the tradeoffs and must be made in developing a flexible instructional design system.

System Features: The Explorer & The Course Creator

The Explorer is a database of instructional resources that includes cases, expert interviews, web sites, research papers, and customizable lessons and courses. These resources may be browsed by content area, resource type, case, or content expert (for video-taped interviews). Users may also conduct detailed searches the Explorer on a variety of search parameters. Once resources are located, users may save them into collections for later use in course design.

Figure 3. Search Results in the Explorer

The Course Creator is a design environment that structures and guides the process of developing a course or unit of instruction. The Course Creator's authoring tools for course design provide varying levels of structured support to instructors who wish to build their own courses. At one extreme, open-ended course authoring tools will allow instructors to create a course "from scratch." At the other extreme, instructors may adopt unchanged any of the exemplar lessons resident in the system. In between, users may edit and reconfigure any lesson or course as needed.

Design issues: Creating Reusable Instructional Resources & Supporting Teacher Customization

One of the major challenges in designing a flexible and modular system is defining the instructional components and how they may be decomposed and reconstructed in meaningful ways. In designing instructional units in the *AIM* system, we were faced with several needs. First, the unit should be *sufficiently flexible to allow for use in multiple contexts, yet not too flexible as to provide little guidance in how to use the unit*. For example, a resource such as a research paper on cognition can be effectively used in a countless lesson plans that focus on very diverse topics. However, without the context of its use (or potential uses), the use of this resource as modular unit is limited from an instructional design perspective. Secondly, the unit had to have the logic of its construction exposed in ways that allow the instructor to understand how to modify it.

Given these needs, the base instructional unit used in the *AIM* system is the *session*. In the *AIM* system, a course is composed of *sessions*. Each session represents an instructional unit and contains three sections: a Session Summary, Resources & Activities, and an Enactment Plan. The structure of instructional units used in the system is depicted in Figure 4.

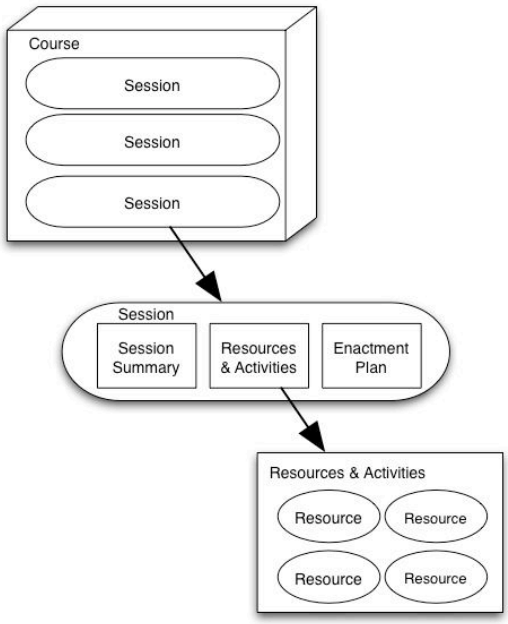

Figure 4. Structure of Instructional Units

Each session contains a context-specific configuration of resources and descriptions of how they are to be used. Session-specific information includes unique descriptions of relevant learning objectives, annotated lists of resources, and an enactment plan (Figure 5). In addition to the resource annotations provided in the session, users can explore individual resources and link to other sessions in which they have been used by others. In this scheme, resources are contextualized within the logic of a session.

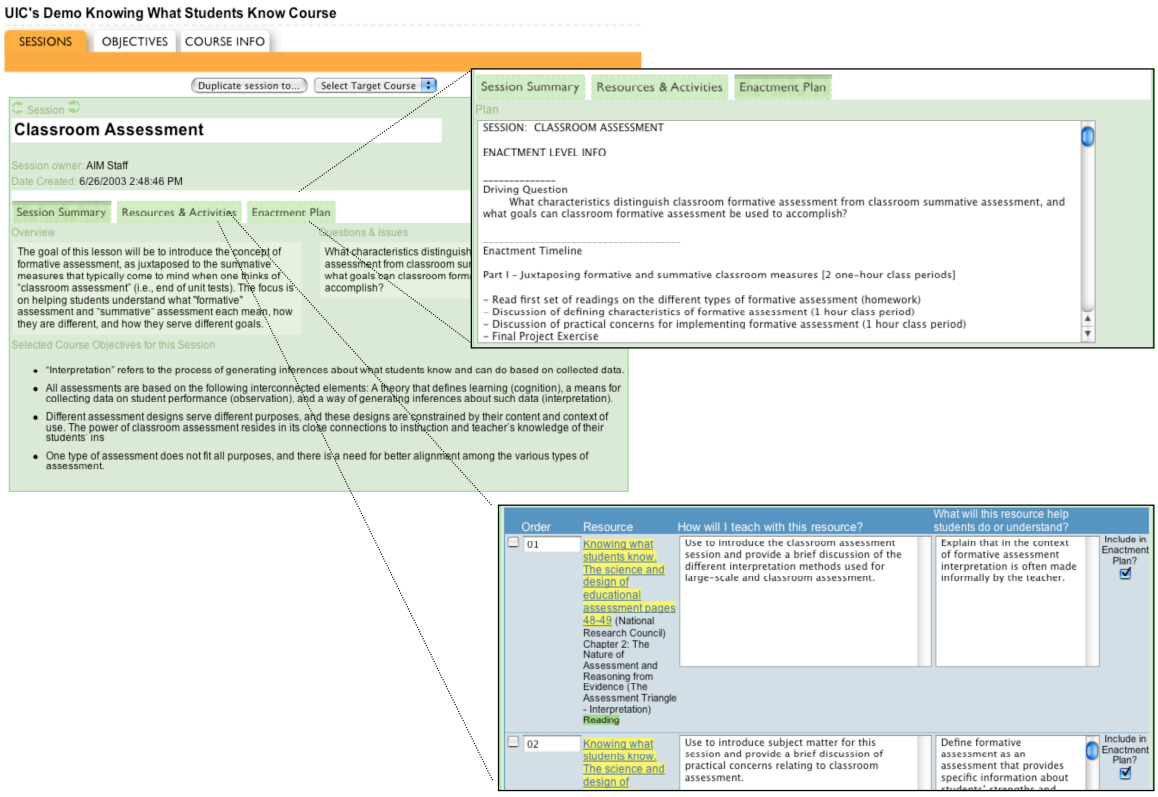

Figure 5. The Structure of a Session: Summary, Annotated Resources, and Enactment Plan

Within sessions, resources can be annotated with two categories of information that show how they serve the overall session goals. One piece of information explains how the resource can be used by the teacher. This information is answered by the question, "How will I teach with this resource?" The other piece of information ties the resource to the outcome sought through its use. This is answered by the questions, "What will this resource help students do or understand?" Figure 6 shows an example of how resources are contextualized in the Resource & Activities section of a session.

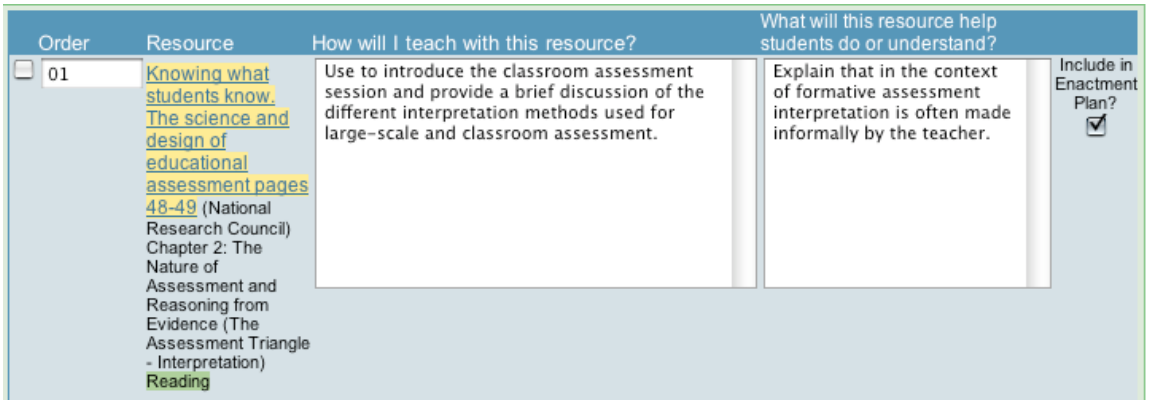

Figure 6. A Resource in the Context of a Session

These annotations serve multiple purposes. For the designer or adapter, they serve as editable prompts for reflecting on the aims of instruction. For an "as-is" user, they provide insights into

the intent and rationale of the designer. Sessions can be adapted to other uses by adding, deleting, or rearranging resources, and by changing any of the editable text.

In the ready-made courses provided in the *AIM* system, the Resources & Activities section of a session typically includes at least one dozen resources that could be used to achieve the overall objectives of the session. Since an instructor would unlikely use all of the resources in one session, a much smaller set can be "included in the Enactment Plan", which further elaborates on how those resources would be used with students.

By providing a large set of resources, this design allows the instructor to adapt the session to the particular needs of his or her instructional context. For designers, sessions can become subject-specific "collections" of saved resources for later examination.

Situating Sessions within Courses. Sessions provide use-specific "wrappers" for collections of instructional resources. They are given coherence in terms of the objectives, resources and activities, and plans for enactment. The user can make sense of this unit by examining its placement in the sequence of the course as a whole. Within a course, sessions can be added, deleted, and reordered as the instructor sees fit. In addition, the Course Objectives feature (see Figure 7) allows users to see how each session has been designed to address overall course goals. Additional features encourage users to consider learning outcomes and student products.

Course Objectives	Context of Use		Elements of Assessment: Cognition			Elements of Assessment: Interpretation					Elements of Assessment: Observation			Nature of Assessment		Purpose of Assessment			Systems of Assessments		Tools for Assessment
	17	18	6	7	8	10	12	9	11	13	15	16	14	1	2	5	4	3	19	20	21
Introduction to Knowing What Students Know	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Introduction to Assessment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Classroom Assessment	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐	☐	☐	☐
Large Scale Assessment	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐	☑	☑	☑	☐	☐	☑	☐
Nature of Assessment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐	☐
Purpose and Systems	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☐	☐
Cognition	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐
Interpretation	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C-O-I Links	☑	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑	☑	☐	☑	☐	☐	☐	☐	☐	☑
Tradeoffs in Assessment Design	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☑	☐
Tradeoffs in Assessment Implementation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
Systems Revisited	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☐	☐
Final Project	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 7. Objectives Matrix

Sharing and collaborating with others. Finally, courses can be exported to simple "course-syllabus" style web pages, so that students can access resources selected by the instructor. Designers and adapters may also share their customized courses with other *AIM* users. Depending on the privileges allowed by the course owner, other users may "view" a non-editable version of the course, or "duplicate" it so that they can customize it as their own. Or, with the necessary password, other's can "collaborate" with the owner on the course's development

Conclusions

The perspective presented in this paper places teachers in the role of designers, not consumers, of instructional materials. This orientation has its basis in research on teachers' interactions with curriculum materials that illustrates the constructive processes that teachers undertake when adapting curriculum materials to their localized needs. Instructional resources that accommodate the constructive and adaptive aspects of curriculum use have the potential not only to meet the needs of a wider audience of teachers, but also to provide opportunities for these teachers to engage more deeply with, and perhaps learn from, the teaching materials.

One way to realize the potential of Teaching by Design is to rethink traditional modes of curriculum design, dissemination and use. Rather than designing curriculum materials as "one-size-fits-all" documents, efforts must be made to make visible the various ways they might be used to accomplish curricular goals. Furthermore, dissemination must occur in a context that supports teachers in making linkages between curricular resources, their own instructional goals and their students' needs. Professional development of this kind would serve not only to enhance teachers grasp of the utility of such resources, but also would provide a context for deepening professional dialogue about instruction and student learning. These efforts would dispel the notion that curriculum use is a matter of following recipes in order to realize a preconceived path of instruction. Rather, they would acknowledge an important reality of all instruction – that it is a creative process – and would open the door for designed artifacts to play a stronger role in stimulating instructional creativity.

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